

AMENDMENT UNDER 37 C.F.R. § 1.111
Appln. No.: 10/646,709

Docket No: Q76993

AMENDMENTS TO THE DRAWINGS

Please remove Figures 2 and 3 and replace with Replacement Figures 2 and 3.

Attachment: Replacement Sheet(s)

REMARKS

Upon entry of the Amendment, Claims 1-13 and 25-35 would be pending in the application. Claim 1 has been amended to add a colon “:” thereto. Therefore, no new matter has been added.

I. Drawings

Referring to page 2 of the Office Action, the insertion of the legend “Prior Art” has been required for Figures 1-3.

Applicants submit herewith replacement drawings of Figures 2-3. The legend “Prior Art” has been added to the phrase Figures 2 and 3.

Figure 1 was labeled with the legend “Prior Art” in the Preliminary Amendment dated August 25, 2003.

II. Claim Objections

Claim 1 has been objected to allegedly because of the informality that a symbol “:” should be added after “in order.” Claim 1 has been accordingly amended.

III. Claim Rejections - 35 U.S.C. § 112

Claims 1-13 and 25-26 have been rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement.

Claim 1 recites *inter alia* a semiconductor substrate which acts as a first copper diffusion barrier layer.

The specification supports the semiconductor substrate recited in claim 1. The specification need not describe the recited claim language in exactly the same words. MPEP §

2163 (2005) (“there is no *in haec verba* requirement”). Referring to Figure 4, Applicant’s specification on page 10 describes as follows:

an MSQ layer 102, SiO₂ layer 107, SiCN layer 108, BCB layer 110 and another MSQ layer 112 are deposited in this sequence on an SiCN layer 100, and a copper interconnect line constituted by a barrier metal layer 104 and a copper layer 106 is formed in the MSQ layer 102. . . . The SiCN layers 100, 108 serve as a copper diffusion barrier. These SiCN layers may be replaced with other layers of, for example, SiN, SiC.

A person of ordinary skill in the art would immediately appreciate that the SiCN layer 100 shown in Figure 4 is an embodiment of a semiconductor substrate which acts as a first copper diffusion barrier layer.

Figure 13 of the specification does not provide that a distinct semiconductor substrate is needed in addition to the SiCN layer 100 as shown in Figure 4. Based on the description at page 10 of the specification, a person skilled in the art would immediately appreciate that the portion including the copper interconnect line 422b surrounded by the dashed line in Figure 13 is an embodiment of the interconnect structure of Figure 4.

Further, the specification supports the second adhesive film recited in claims 25 and 26.

Claim 25 recites *inter alia* that a second adhesive film constituted essentially by a silicon-based compound having an aromatic ring in a molecule of said silicon-based compound having a specific dielectric constant of 2.5 to 2.6 is formed between a SiCN layer and a low dielectric constant film.

Claim 26 recites *inter alia* that a second adhesive film constituted essentially by a silicon-based compound having an aromatic ring in a molecule of said silicon-based compound having a

specific dielectric constant of 2.5 to 2.6 is formed between a SiO₂ layer and a low dielectric constant film.

Pages 14 to 15 of the specification describes as follows:

in addition to the BCB layer provided between the SiCN layer 108 and the MSQ layer 112 as shown in FIG. 4, a constituted by BCB layer may be provided between the SiCN layer 100 and the MSQ layer 102, or between the MSQ layer 102 and the SiO₂ layer 107. The above-mentioned interconnect structure is shown in FIGS. 6A and 6B.

The MSQ layer 102 is an embodiment of the low dielectric constant film recited in claims 25 and 26. The BCB layer 120 as shown in Figure 6A and the BCB layer 121 as shown in Figure 6B are embodiments of the a second adhesive film.

Figure 6A shows that BCB layer 120 is between MSQ layer 102 and 100 SiCN. In this regard, Figure 6A supports claim 25.

Figure 6B shows that BCB layer 121 is between SiO₂ layer 107 and MSQ layer 102. In this regard, Figure 6B supports claim 26.

IV. Claim Rejections - 35 U.S.C. § 103

The Office Action includes three new grounds for rejection under 35 U.S.C. § 103, as follows:

- (1) Claims 27, 29-30, and 32-35 have been rejected under 35 U.S.C. § 103 as allegedly being unpatentable over U.S. Published Application No. 2004/0173908 to Barth et al. ("Barth '908") in view of U.S. Published Application No. 2003/0067077 to Lee ("Lee '077").

(2) Claim 28 has been rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Barth '908 in view of Lee '077, further in view of Applicant's admitted prior art.

(3) Claim 31 has been rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Barth '908 in view of Lee '077, further in view of U.S. Patent No. 6,313,517 to Lauterbach et al.

Claim 27 recites *inter alia* that an adhesive film is constituted by a silicon-based compound having an aromatic ring in a molecule of said silicon-based compound.

Figure 2 of Barth '908 shows an interconnect structure comprising in upwards order cap layer 117, adhesion promoter 118, and ILD 119. Barth '908 is deficient in that it fails to teach that the adhesion promoter layer 118 is a silicon based compound having an aromatic ring in a molecule of the silicon-based compound.

Lee '077 teaches that the organic copper diffusion barrier layer 118 of Figure 1I is formed over the substrate 100 and covering the first copper layer 116a, and the first dielectric layer 110. *See* paragraph [0019]. Lee '077 teaches the organic copper diffusion barrier layer 118 at least comprises a benzocyclo polymer. *See* paragraph [0019]. Lee '077 discloses that the organic copper diffusion barrier layer 118 has good adhesion to copper layer and organic dielectric layer, and thereby a crack issue can be avoided. *See* paragraph [0019]. Figure 1I shows that organic diffusion barrier layer 118 is provided between a first dielectric layer 110 and a second dielectric barrier layer 120 or between a first copper layer 116a and a second dielectric layer 120.

Accordingly, Lee '077 fails to teach or suggest that the organic copper diffusion barrier layer 118 thereof has good adhesion to the cap layer disclosed in Barth '908. For example, Lee

'077 fails to teach or suggest that the organic diffusion barrier layer 188 thereof has good adhesion to SiCN. Given that Barth '908 teaches a cap layer composed of SiCN, a person of ordinary skill in the art would not have been motivated to use the benzocyclo polymer disclosed in Lee '077 to produce the adhesion promoter layer 118 disclosed in Barth '908.

Claims 28-35 depend from claim 27. Therefore, claims 28-35 are unobvious for at least the same reasons as claim 27.

Further, claim 33 recites *inter alia* that the organic low dielectric material is a silicon-containing organic compound. Lee '077 discloses that an organic dielectric layer 110 or 120 comprises spin-on polymer, such as FLARE, SiLk, PAE-II, Velox, etc., or spin-on glass. *See* paragraph [0021]. In this regard, Lee '077 is deficient in that it fails to teach or suggest that the organic diffusion barrier layer 188 thereof has good adhesion to a silicon-containing organic compound. In this regard, a person of ordinary skill in the art would not have been motivated to use the benzocyclo polymer disclosed in Lee '077 to produce the adhesion promoter layer 118 disclosed in Barth '088.

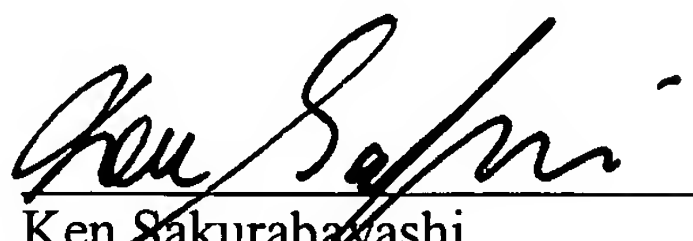
In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,


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